Fisheries and Aquaculture - Frequently Asked Questions

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BC's Salmon Farming Industry

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- Are we seeing an increase in disease outbreaks in British Columbia with the growth of fish farming?

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- So sea lice pose a risk to human health?
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- Are sea lice from salmon farms killing wild pink salmon in the Broughton Archipelago?
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- Under what authority is SLICE® administered to fish on BC farms?
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IHN Virus

- What causes IHN virus outbreaks on farms?
- Does IHN virus on farms pose a risk to wild salmon stocks?
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- What treatment is available for fish infected with the IHN virus?
- Can people be affected by the IHN virus?

Human Heaith and Safety

- Is eating farmed salmon safe?
- Are there traces of antibiotics in the farm fish sold in grocery stores?
- Does farmed salmon contain PCBs, dioxins and other harmful substances?
- Does farmed salmon have a higher fat content than wild salmon?
- Does farmed salmon contain artificial colouring?

Non-Salmon Species

- What fish species, other than salmon, are farmed in BC?
- How many farms are raising sablefish and other non-salmon species?

- How long has sablefish farming been permitted in BC?
- Have environmental assessments been done on farming these other species?
- Will farming species such as sablefish have negative impacts on the wild fishery?
- If it will cause a decrease in revenue to the wild fishery, why doesn't government prohibit sablefish farming in BC?
- Will sturgeon culture take place in net-pens, as with salmon?
- Will farming these species introduce new diseases or cause other environmental concerns?
- Why start culturing new species now?

GENERAL

Why did government lift the moratorium on new salmon farms in 2002?

The Ministry of Agriculture, Food and Fisheries considered all available scientific information on the sustainability of salmon farming and found the balance of this information to indicate that salmon aquaculture can be an environmentally responsibly activity. Some of the studies considered were:

- The B.C. Environmental Assessment Office's comprehensive two-year review of salmon aquaculture, The Salmon Aquaculture Review, released in 1997. It considered the risks at that time to be manageable and recommended proceeding with caution.
- A study by the U.S. National Oceanic and Atmospheric Administration (NOAA) released in September 2001. It concluded that, as practiced, salmon aquaculture has a low impact on the environment of the Pacific Northwest.
- A December 2001 study on sea lice by Fisheries and Oceans Canada found that wild salmon near salmon farms in the Queen Charlotte Strait did not have elevated levels of sea lice as compared to those that had no contact with salmon farms.
- In December 2001, the Ministry of Agriculture, Food and Fisheries contracted a study on the net strength of containment pens used in British Columbia. That study has been used to revise escape prevention standards that are practiced on all BC fish farms.

Further information regarding salmon aquaculture will continue to emerge and improvements will continue to be made to the regulation and management of the salmon aquaculture industry. The government is committed to developing this industry in a responsible manner. Should legitimate scientific findings indicate that further or different action is required by government, we will respond in order to ensure our commitment to environmental sustainability is upheld.

How can government claim that allowing expansion of the aquaculture industry will reduce environmental impacts?

In order to remain competitive, the major salmon farming companies aim to produce a specific volume of fish annually. Ideally, this production will take place on a portion of their farm sites, while other sites remain fallow. When the moratorium was in place (1995-2002), one of the challenges faced by the industry was the inability to rotate production among multiple sites. Not allowing sites to rest between production cycles can put pressure on the ocean floor below the sites. Now that the moratorium has been lifted, companies are able to apply for additional sites. With more sites, unused sites can remain fallow for longer, giving the seabed more time to return to a natural state. During the first year since the moratorium was lifted, only a small handful of new sites were approved. All new site applications are subject to a rigorous review by both the provincial and federal governments, and proposed new sites will only receive approval if they meet the high standards in place for aquaculture operations.

Do fish farmers kill seals, sea lions, and birds that prey on their fish?

The aquaculture industry has minimized predation by mammals and birds through improved siting and the use of barrier nets around the farms. Fisheries and Oceans Canada (DFO) closely monitors predator control on salmon farms, and licences farmers to kill marine mammals only as a last resort, if other deterrents have not worked. Marine mammal predator control licences are issued consistent with DFO's conservation mandate. DFO data show a significant decline in seal and sea lion kills over the past few years. DFO is working with the industry to phase out the practice of lethal marine mammal control and to find effective, non-lethal solutions to predatory marine mammals.

What species of salmon are farmed in BC?

In 2002, 85,400 tonnes of farmed salmon were processed in British Columbia. Atlantics made up 72,800 tonnes (85%), 10,400 tonnes were chinook (12%) and the remaining 2,300 tonnes (3%) were primarily coho.

MAFF Salmon Aquaculture Statistics page

BC'S SALMON FARMING INDUSTRY

Why is farmed salmon available more often from fish retailers than wild salmon?

B.C.'s moderate climate and clean ocean allow year-round production on BC farms and a steady, predictable supply of fish to retailers. Other advantages of farmed fish include its consistent size and weight and the freshness afforded by the farms' proximity to processing facilities. Wild fish are available fresh during only a few months of the year and vary in abundance. Nevertheless, some important niche markets exist specifically for wild seafood products.

Are the world's fish stocks being depleted to feed farmed salmon?

Both wild and farmed salmon consume small fish and crustaceans as the main part of their diet. Feed given to farmed salmon contains fish meal and fish oil, in addition to vegetable-based binders and oils.

A worldwide fishery spanning Norway, Iceland, Denmark, Chile and Peru has been supplying the meal and oil industry for many decades. It produces about 6 million tonnes of meal per year from small, bony fish that are generally not destined for human consumption. Before fish farming, all fish meal was used in feed for land-based livestock. According to the U.N.'s Food and Agriculture Organization, the fish stocks that supply the fish meal industry are not over-fished. The portion now used by the aquaculture industry only takes away from these other industries, and has not increased the amount of fish taken for fish meal. Currently, about a third of the world's fish meal supply is used in aquaculture, with the remainder going to feed for land animals.

Research is ongoing to reduce the amount of marine-origin protein in fish diets and replace it with vegetable-based alternatives such as canola. There is confidence that worldwide fish farming can continue to increase production without increasing pressure on the global fishmeal supply.

How does salmon farming contribute to the local BC economy?

Salmon aquaculture contributes enormously to our British Columbia economy - more than 3,500 direct and indirect jobs. Ninety percent of those jobs are in coastal communities, and 50 percent of those jobs are for women and First Nations. These are full-time, year-round jobs. Eight First Nations on the coast of British Columbia are involved in salmon aquaculture. The unemployment rate in

Klemtu, a First Nations community on BC's central coast, has been reduced from 90 percent to 30 percent since aquaculture came to the community. For more information, see: http://www.kitasoo.org/

Both Canadian and "off-shore" companies operate salmon farms in British Columbia – a mix that is common across most businesses and industries operating in the province. The high start-up and capital costs associated with salmon farming make the industry prohibitively expensive to smaller companies, and most farms in the province are operated by multi-national companies. Regardless of the location of their head offices, however, aquaculture companies operating in BC provide employment for coastal community residents and provide spin-off economic benefits to many local supporting businesses.

Shellfish aquaculture is quite different in this respect, as most shellfish aquaculture operations are owned by family businesses.

MAFF Salmon Aquaculture Statistics page

MAFF Shellfish Aquaculture page

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FARMING ATLANTIC SALMON

Why are Atlantic salmon farmed in BC?

The Province supports the culture of both Pacific and Atlantic salmon species. The choice of which species, strain and stock of fish to raise is a business decision made by each aquaculture company. For a number of reasons, Atlantic salmon is more commonly farmed than the Pacific species. The following factors play into this choice:

- Atlantic salmon often have better growth and survival rates on the farm than Pacific salmon.
- Atlantic salmon are a more docile stock than Pacific species.
- There is a strong international market demand for Atlantic salmon.
- Processors find that Atlantic salmon provide more meat and create less waste per fish.
- Pacific salmon species pose a somewhat increased risk to local stocks in the event of an escape as wild and farmed Pacific species are capable of interbreeding; Atlantic and Pacific salmon are unable to interbreed.

In addition to Atlantic salmon, Chinook and coho salmon are also raised in British Columbia. The Pacific species currently account for approximately 15% of British Columbia production.

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Are there any genetic risks associated with farming Atlantic salmon in BC?

The common concern cited around genetic risks is that "domesticated" farm salmon have different characteristics than their wild counterparts, and that if they were to breed with wild fish, their "domestic" traits would be passed on, resulting in less "fit" offspring with a reduced ability to survive in the wild.

Atlantic and Pacific salmon species have never been seen to interbreed in the wild. Laboratory trials to breed the two species have also had poor results. Therefore, even if Atlantic salmon escape from the net-cages, there is very little chance of any genetic interaction with wild stocks.

Atlantic Salmon Watch Program

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What about the genetic risks of escaped Pacific salmon species?

The potential for genetic interaction between farmed and wild Pacific salmon is somewhat greater than that between farmed Atlantic salmon and wild Pacific salmon. Some behavioral and reproductive characteristics of hatchery- and farm-reared Pacific salmon have been shown to differ from those of their wild counterparts. If escaped farm fish do interbreed with wild fish, the competitive fitness of the wild stocks may be compromised.

However, billions of hatchery-reared Pacific salmon have been released from North American enhancement facilities every year for decades. Relative to this, the potential contribution by escaped farm fish to the gene pool is negligible.

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How can I tell if a salmon is Atlantic or Pacific species?

Some visible differences exist between the two. For example, Atlantic salmon have black spots on the gill cover, while none of the Pacific species does. Anyone finding an Atlantic salmon in the wild is asked to report it to the Atlantic Salmon Watch Program. Visit the Atlantic Salmon Watch website for more information.

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ESCAPES FROM SALMON FARMS

How do salmon escape from farms?

The most common causes of escape incidents have been:

- system failure (e.g. due to storm damage, etc)
- boat operations (e.g. damage by boat propellers)
- net failure due to activities by predators (e.g. seals, sea lions)
- net failure due to poor or inadequate maintenance
- net failure due to known or suspected vandalism
- fish handling errors

Annual farm inspections are carried out by provincial enforcement staff who carefully review farm operations. Types of activities that have contributed to escape events in the past are given special attention.

MAFF Marine Escape Reports

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How big a problem are escaped farm salmon?

The Provincial government and the BC salmon farming industry are constantly striving to achieve "zero escapes." On occasion, some salmon do escape from the containment nets, but with many more precautions in place, escapes are steadily declining. Since January 2002, there have been no major escape events reported – and all escaped fish must, by law, be reported.

From time to time, fishers catch Atlantic salmon in their nets. Small numbers are also recovered in streams. Whenever possible, these fish are studied by the Atlantic Salmon Watch Program. A very small percentage of the wild-caught Atlantic salmon studied have had prey items in their stomach. In fact, survival of escaped farm fish is very poor - the vast majority of reported escaped Atlantic salmon never make it into commercial fishing nets, nor are they spotted in stream surveys, suggesting that escapees are very poorly adapted to the "wild" marine environment.

Escaped farm salmon have been caught in small numbers by fishermen in B.C., Washington and Alaska since 1991. Despite the fact that low numbers are present in our waters, no population of Atlantic salmon has become established on the West Coast of North America.

Data compiling all sightings and captures of Atlantic salmon in B.C., as well as Washington and Alaska, indicate that in 2002:

- Reported escapes of Atlantic salmon in B.C. was down 73% from the previous year.
- The number of adult Atlantic salmon found in fresh water was down 66%.
- The number of Atlantic salmon caught in Alaska was down 80%.

MAFF Escape Statistics

What is the government doing to stop farm salmon from escaping?

The Ministry of Agriculture, Food and Fisheries is addressing the risks of escapes through its Escape Prevention Policy. Under provincial regulation, standards must be met for specific aspects of farm operations and all companies must:

- Submit binding escape prevention and response plans that describe how they will comply with the escape prevention standards;
- Ensure nets used to hold salmon meet minimum strength requirements;
- Meet monitoring requirements, including monthly dive inspections, daily systems checks and anchor inspections;
- Maintain detailed records, including records of fish inventory, inspections, staff training and escapes; and
- Implement escape response plans in the event of an escape.

MAFF also co-funds the Atlantic Salmon Watch Program with the federal government.

What is the salmon farming industry doing to stop farm salmon from escaping?

The aquaculture industry has a very strong incentive to prevent fish from escaping, as each escaped fish represents a direct economic loss to the company. The industry increasingly employs practices and equipment specifically to reduce the risk of escapes. Modern farms typically use more than 200 tons of anchors to stabilize the farm structures and one or more layers of containment nets and predator deterrent nets around the farm. In addition, only highly trained staff undertake higher risk activities such as moving fish into and out of the net-pens. Technology is continually evolving in this area and aquaculture facilities are regularly upgraded to maximize efficiency, with the goal of eliminating escapes entirely.

The BC Salmon Farmers Association has also developed a Code of Practice that has been adopted by all member companies and includes standards for minimum net strength, net testing, and escape-response plans. This Code can be viewed at http://www.salmonfarmers.org/industry/code.html.

Are escaped Atlantic salmon found in the wild?

Escaped farm salmon have been caught in small numbers by fishermen in B.C., Washington and Alaska since 1991. Despite the fact that low numbers are present in our waters, no exotic population of Atlantic salmon has become established on the west coast. Figures on the abundance of Atlantic salmon found in freshwater streams in BC have shown a steady decrease of escapees

and very low numbers are present today.

Atlantic Salmon Watch Program

Are escaped Atlantic salmon competing with native steelhead stocks for habitat and food?

Steelhead sometimes experience low survival rates in the wild. However, this is attributed to poor ocean survival, not in-stream competition with Atlantic salmon. The numbers of Atlantic salmon enumerated each year in BC rivers are extraordinarily small, particularly when compared to Pacific species such as steelhead. Ministry of Water, Land and Air Protection staff conduct steelhead assessment surveys and are regular contributors to the Atlantic Salmon Watch assessment process. Should a significant population of Atlantic salmon be observed in a steelhead river – or any other river – Atlantic Salmon Watch is mandated to remove the Atlantic salmon to reduce the possibility of colonization.

Would there be less risk to the environment if only female salmon were farmed?

With no males to fertilize eggs, the females would be unable to reproduce in the wild if an escape occurred. This is an approach already being used by some BC farms raising Chinook salmon. Provincial biologists are working with the aquaculture industry to evaluate the feasibility of raising all female Atlantic salmon.

Does government rely on companies to report and monitor escapes on their own?

No. The Ministry is actively involved in escape prevention and response. All active salmon farms are inspected a minimum of once per year by MAFF inspectors to ensure compliance with legislated and licensed requirements. During these inspections, farmers are required to provide information such as:

- inspection and maintenance records for nets and other fish-containment structures;
- inventory records, detailing the movements of fish to and from the farm;
- escape response plans;
- information about staff training; and
- best management practices plans, explaining how a wide range of operational activities – from boat operations to predator-attack prevention – are conducted and how they meet environmental objectives.

Salmon farm operators are required, by law, to report any escape or suspected escape within 24 hours of its detection. Farmers found to be in contravention of the regulations may face penalties ranging from a written warning, issuance of a violation ticket, charges recommended to Crown counsel or a recommendation of suspension or revocation of the operating licence.

What actions take place after an escape occurs?

Whenever there is an escape from a fish farm in British Columbia, the following steps are taken:

By law, farm operators must immediately initiate Escape Response Plans, notify the Ministry of Agriculture, Food and Fisheries within 24 hours, and provide a written report within one week.

The Ministry will immediately launch an investigation and inform Ministry compliance and enforcement staff, Atlantic Salmon Watch, Fisheries and Oceans Canada and the Ministry of Water, Land and Air Protection of the escape.

Investigations by MAFF staff generally include site visits, a visit to company headquarters, and interviews with farm workers, headquarters staff, and other appropriate individuals (for example, divers contacted by the company to inspect nets).

The Ministry has six months to investigate and initiate a complaint against a company after the incident, if appropriate.

Aquaculture Regulation

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Can salmon farmers recapture escaped fish?

After an escape or suspected escape, the most important action for the farmer to take is to ensure that immediate corrective action is taken to prevent further escapes. Under provincial regulation, the farm's "escape response plan" must be fully executed upon discovery of an escape or suspected escape. (Aquaculture Regulation)

Farmers are also required to take all reasonable measures that will result in the recapture of a significant portion of the stock and that will not detrimentally impact on wild stocks. These measures must be consistent with federal, provincial and local government enactments.

For many reasons, however, escape recovery is often not effective. Fish escapes can occur during inclement weather conditions, can go undetected for a few hours (if, for example, a seal has torn open a net), and escaped farm fish are unlikely to remain in the immediate vicinity of the farm or in a close bunch to facilitate their recapture once they escape. As a result, the BC government puts most of its efforts into escape prevention, rather than recovery, as this is more likely to reduce the impacts of escapes.

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Researchers are finding Atlantic salmon in BC streams. Does this mean they are colonizing here?

Small numbers of wild-born Atlantic salmon have been found in three B.C. rivers. However, the available scientific evidence overwhelmingly indicates that Atlantic salmon escapees cannot successfully colonize in our waters. The numbers of Atlantics found have remained very small over several years, and there remains very little risk of a self-sustaining population of Atlantics becoming established here. The Atlantic Salmon Watch Program is closely monitoring streams where Atlantic salmon have been seen or have spawned in the past. There is no evidence that Atlantics have successfully established in those streams.

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ATLANTIC SALMON WATCH PROGRAM

What is the Atlantic Salmon Watch Program (ASWP)?

The Atlantic Salmon Watch Program (ASWP) is a joint federal-provincial program that operates year-round to enumerate and document escaped Atlantic salmon. This program was established as a cooperative effort with this ministry and Fisheries and Oceans Canada in 1991. The ASWP monitors the abundance, distribution and biology of Atlantic salmon in the waters of BC. Farmers,

fishermen and anglers report Atlantic salmon escapes and catches to the program through farm escape reports, a hotline, fisheries catches and the ASWP website.

Atlantic Salmon Watch Program

How does the ASWP keep track of escaped Atlantic salmon?

Escapes recorded by the ASWP are a compilation of mandatory escape reports from aquaculture companies and reported marine catches from commercial fishers and processing facilities. Sightings and captures of Atlantic salmon in Washington and Alaska are also recorded by the ASWP. Undoubtedly, some fish are found and are not reported as no system is foolproof. Every year since 1991 the program has improved its ability to survey the abundance, biology and distribution of Atlantic salmon in the Pacific Ocean.

Atlantic Salmon Watch Program

Is the data from the ASWP reliable?

Data from the Atlantic Salmon Watch Program is posted on the internet and is readily available to the public. Transparency of the program is further ensured by the fact that all government programs are bound by freedom of information legislation. The work of the ASWP is coordinated with that of state agencies in Alaska and Washington to ensure accurate reporting of escaped Atlantic salmon along the entire coast.

Atlantic Salmon Watch Program

REGULATING THE AQUACULTURE INDUSTRY

What is the role of the government of British Columbia in regulating the salmon aquaculture industry?

The success of the aquaculture industry depends on farms being environmentally sustainable and socially acceptable, as well as economically viable. Government's role is to ensure that the aquaculture industry meets these objectives. Government sets the terms and regulates the activities of farms licensed by the province.

The Ministry of Agriculture, Food and Fisheries (MAFF) is responsible for adjudicating aquaculture applications and for issuing aquaculture licences under the provincial Fisheries Act. Aquaculture operations are subject to the conditions of this act, and other provincial legislation, including: the *Aquaculture Regulation*, the *Waste Management Act*, the *Finfish Aquaculture Waste Control Regulation*, the *Water Act*, the *Land Act*, the *Wildlife Act*, the *Right to Farm Act*, and other relevant provincial, municipal and federal legislation.

Regular inspections are carried out on farm sites by provincial enforcement staff in order to ensure compliance with the relevant standards and regulatory requirements.

MAFF Compliance and Enforcement page
Provincial Legislation page

How does government monitor the aquaculture industry?

The Ministry of Agriculture, Food and Fisheries conducts annual inspections and spot-audits of all active salmon farms to assess compliance with legislative and regulatory provisions.

The Ministry of Agriculture, Food and Fisheries and the Ministry of Water, Land and Air Protection are responsible for compliance and enforcement of the finfish aquaculture industry. "Compliance" activities are conducted by MAFF and include awareness, education, monitoring, and inspection activities. "Enforcement" activities are carried out by MWLAP and include verifying and substantiating alleged offences and recommending and implementing necessary enforcement responses.

MAFF Compliance and Enforcement page

The Environmental Assessment Office (EAO) made a number of recommendations for salmon aquaculture in 1997. Have they been implemented?

Thirty-nine of the EAO's 49 recommendations have been adopted as they were put forward in the Salmon Aquaculture Review. Another six have been partially implemented. Four recommendations have not been adopted either because a different approach has been taken to address the topic or because the recommendation is not applicable to current programs or to provincial activities or responsibilities.

All provincial aquaculture initiatives undertaken since 1999 have been developed based on the spirit and intent of the EAO recommendations and the province now considers implementation of the EAO recommendations to be complete. Work will continue in order to make continued improvements to the management and performance of the B.C. aquaculture industry.

Status of Salmon Aquaculture Review Recommendations (updated April 1/03)

EAO Salmon Aquaculture Review

FARM SITING

Are local communities and the public consulted when new aquaculture sites are proposed?

Consultation is an integral component of the review process for aquaculture projects. Both the provincial and federal governments have policies in place that require public consultation on government activities.

Government also assesses aboriginal interests prior to making decisions with respect to Crown land dispositions or water allocations. Consultation with First Nations is an integral part of the aquaculture site assessment process.

MAFF Public Consultation page
Land and Water BC First Nations Consultation page

What is required from aquaculture companies before they are granted a new site?

Any person or company applying for a new aquaculture site faces a rigorous process of assessment and evaluation. In order to apply for a new site (or to relocate an existing site), aquaculture operators are required to submit a detailed proposal that describes all aspects of the proposed site and facility. This application requires the completion of extensive surveys and studies of the area. The following information must be included:

- a detailed description and maps of the site location

- the planned layout and dimensions of all buildings and structures at the facility
- the proposed production levels and species to be cultured
- information on local First Nations
- nearby environmental resources and human activities
- detailed surveys of the seabed under the farm
- waste management plans

Marine Finfish Application Guide page

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Where are aquaculture operations located in BC?

Current List of Salmon Farms
Map of BC Salmon Aquaculture Sites (jpg)
Aquaculture Wizard (Locate any aquaculture operation on a scalable map)

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Does coastal planning play a role in locating aquaculture sites?

Yes. The Aquaculture Opportunities Study is an initiative of the Ministry of Sustainable Resource Management. This process has served to identify areas where aquaculture tenure applications have a reasonable chance of success, and areas that may not be suitable for aquaculture due to habitat considerations, social resources or other issues.

For more information see the Aquaculture Opportunities Study page

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What criteria are used to determine if a site is acceptable for aquaculture?

This question is answered comprehensively on the following web pages:

What Makes a Good Aquaculture Site?
Marine Finfish Application Guide page

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FISH WASTE

What are fish farm wastes?

All wild and farmed fish excrete "wastes", or feces, as a by-product of digestion. Because the feeding of farm fish is strictly monitored by farmers, farm fish are generally more efficient at converting the material they eat into flesh than are wild fish. This feed conversion efficiency is continually improving as farmers and feed manufacturers improve feed formulations, fish husbandry practices and feeding regimes to reduce feed wastage. Feed is the single most expensive input on a farm and reducing uneaten feed is a top priority for farm managers.

Other wastes produced by a farm include uneaten feed pellets, dead fish and trace amounts of other materials used on the site. All material considered "waste" is subject to handling requirements that prevent impacts to the marine environment. Fish that die due to predator attacks, disease or other causes are disposed of at approved land-based disposal facilities. According to divers who examine the environment under fish farms, vibrant communities of organisms often flourish there, due to the addition of organic material from the farm.

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How much fish waste is generated by salmon farms?

Some sources have claimed that salmon farms produce extremely high levels of feces, even comparing a single farm's waste output to that of a city of 1.5 million people. Such a comparison is problematic and inaccurate for several reasons. The primary concern with discharge from salmon farms, from an ecological perspective, is the addition of nutrients (i.e. nitrogen and phosphorus) to the marine environment. In addition to feces, municipal sewage can contain industrial waste, human pathogens, medicinal residues, heavy metals and toxic organic compounds produced by industrial and agricultural activities.

Farms produce varying amounts of waste as the fish progress through their lifecycle, with the maximum output occurring at the end of the cycle, when the fish reach harvest weight.

An average BC salmon farm produces approximately 2,000 tonnes of fish per year (400,000 fish, 5kg each harvest weight). The fecal solids produced by these fish are equivalent to those produced by about 125,010 people. In terms of the raw phosphorus (P) and nitrogen (N) output from the same farm, these are equivalent to the P and N produced by approximately 30,000 and 50,000 people respectively. The average amount over the year is actually lower, as these calculations are based on the maximum production (which is reached only at the end of the production cycle).

These calculations are based on those used and explained in an article by University of Idaho professor Ronald Hardy.

What impact do farm wastes have on the ocean?

The area affected by wastes is generally limited to the sea floor in the immediate vicinity of the farm structures. The impacts of these wastes are temporary as the wastes are assimilated by the marine environment over time. The extent of the area affected is influenced by a variety of factors, such as depth and site circulation dynamics, but in the majority of sites, the effects of organic wastes can not be detected more than 50 metres beyond the cages.

In most cases, the ocean floor below a salmon farm will return to its original state within several months of harvesting the fish. Most salmon farming companies leave their sites "fallow" for a period of time after each production cycle to allow this recovery. Farm operators may also change the location of the net-cages within the tenure to produce a similar effect.

A key factor to controlling salmon farm impacts is farm siting. Farms are sited in areas where currents and water movement naturally disperse farm wastes and where impacts to the benthic environment will be minimized.

MAFF Farm Siting page

What regulations are in place to ensure farm fish wastes do not harm the environment?

The impact of fish waste generated by farms is regulated through environmental standards set by the Ministry of Water Land and Air Protection. Under the Finfish Aquaculture Waste Control Regulation, farmers are required to monitor the marine environment around the farm for changes in the benthic environment under the farm.

Key features of the regulation include:

- The use of specific chemical and biological indicators to gauge the health of the benthic community (ocean bottom-dwelling organisms);
- These indicators are monitored to ensure there are no unacceptable or long-term changes in the benthic communities near a farm compared to background levels;
- Pre-operational baseline inventory must be taken to record benthic conditions before farm production begins;
- Farmers must follow a monitoring and reporting program, consisting of regular sediment

sampling and/or underwater videos.

MWLAP - Finfish Aquaculture Waste Control Regulation page

How does government ensure industry compliance with the waste regulation?

The Ministry of Water, Land and Air Protection performs annual environmental monitoring and auditing to assess industry compliance with the standards and to assess effects on the marine ecosystem. Specific monitoring activities by government include:

- Conducting reviews of industry environmental monitoring data
- Annual monitoring of sediments at salmon farms
- Development of appropriate sampling protocols and quality assurance/control programs
- Establishing priorities for ministry monitoring of sediments at salmon farms
- Conducting environmental sampling at salmon farms, providing feedback to the facility.

What happens if a farm is found to be causing environmental damage?

Farmers are required, by law, to monitor the area around the farm for changes to the quality of the water or the sediments. Specific measurable standards are established in the Finfish Aquaculture Waste Control Regulation that may not be exceeded at farm sites. If government inspectors suspect non-compliance by a farm, an investigation may be initiated. Farmers can face enforcement actions if their farm sites are found to exceed the acceptable limits set out in legislation. These enforcement actions can range from warnings, tickets, and administrative penalties, to orders or formal prosecutions.

MWLAP - Finfish Aquaculture Waste Control Regulation page

FISH HEALTH AND DISEASE TRANSFER

Do farmed Atlantic salmon introduce new diseases into BC waters?

Atlantic salmon and indigenous wild salmon are subject to the same disease pathogens. Atlantic salmon have been raised in pens on the west coast since the early 1970's, and have never introduced an exotic disease into British Columbia. Farmers place a great amount of importance on maintaining healthy stocks, as sick fish represent a direct economic loss to their business.

All salmon smolts that are placed into marine net pens in BC are free of disease, and any disease they experience through their lifetime on the farm has originated in the wild environment. Any fish imported into British Columbia must be tested prior to entrance fro the presence of disease agents. BC has a strict "eggs only" policy for importation of salmon that reduces the risk of introducing any disease agent.

In addition, a federal-provincial introductions and transfers committee (ITC) was created specifically to consider potential ecological, genetic and fish health risks associated with moving aquatic organisms in the province (fish and aquatic plants). The ITC is made up of biologists and other fish health professionals who advise government on fish transfer issues. This committee, in tandem with a host of regulations and polices, will ensure that further development of any finfish aquaculture will take place in a responsible way and will be subject to enforceable standards.

Federal-Provincial Introductions and Transfers Committee page
National Code on Introductions and Transfers of Aquatic Organisms

Do all farmed salmon receive drugs and medications?

No. Many farmed salmon are never treated with any medication throughout their entire lifecycles. This is due to improvements in fish husbandry and handling that reduces stresses on the fish that can make them more susceptible to diseases. When medications are required to maintain health, they must be prescribed by a licensed veterinarian and are administered for only as long as required to treat the disease. A mandatory withdrawal period must be observed after any treatment before fish are harvested for consumption.

MAFF Therapeutant (Antibiotic) Use in Aquaculture page

MAFF Therapeutant Use & Recordkeeping page

Can diseases from farm salmon be transferred to other species?

An orca death in 1996 caused some public concern about the possibility of disease transferal to whales from farmed salmon. An exhaustive investigation was undertaken at that time by the Chief Veterinarian of BC that concluded that the orca death was not linked in any way to farmed salmon. In fact, there has been no documented case in British Columbia of a whale health being affected in any way by fish farms or escaped salmon.

Are we seeing an increase in disease outbreaks in British Columbia with the growth of fish farming?

There has been no increase in disease outbreaks with the growth of fish farming. Rather, improved farming techniques have reduced the loss of fish to disease in salmon farms. MAFF fish health staff conduct surveillance of farmed fish health on a routine basis.

SEA LICE

Do sea lice pose a risk to human health?

No, there is no risk to human health from sea lice. Sea lice live on the outside of the fish and feed on mucous on the outer surfaces of the fish. They would not affect human health if eaten, but the lice usually fall off or are cleaned off during harvesting or processing activities before the fish reach the consumer.

Do farmed salmon transfer sea lice to wild salmon?

Sea lice are a naturally occurring parasite that can affect both farmed and wild salmon. Pacific salmon species have lived with consistent background levels of sea lice for centuries, and have developed a natural tolerance to this parasite. Because of this, farmed Atlantic salmon are somewhat more susceptible to sea lice in the Pacific and farmers raising Atlantic salmon must be even more diligent in their monitoring of and response to sea lice on their farms.

Sea lice can be transferred in both directions between farmed and wild salmon. Their levels are controlled on farms through proper siting, raising only a singe age-class of salmon on a farm to break the life cycle of the sea lice, and through the strictly-controlled use of medication if an

outbreak does occur. In general, farm fish carry lower levels of sea lice than wild adult salmon, due to the ability to control lice levels on the farm.

MAFF Sea Lice page
DFO Sea Lice report

Are sea lice from salmon farms killing wild pink salmon in the Broughton Archipelago?

Fish farms have been present on our coast for over 20 years. Reduction in pink salmon returning to some rivers in the Broughton area is a relatively new phenomenon, and has come on the the heels of record high pink returns recorded in 2000 and 2001.

In July 2001, in response to concerns about sea lice on salmon farms, federal and provincial government staff sampled sea lice levels on wild salmon both in areas close to farms and in areas with no farms nearby. There was no difference in sea lice levels recorded between the two. Findings indicated the lice numbers on juvenile wild fish were average, with only a few fish having high numbers. There is no evidence that lice from farmed fish have detrimentally affected wild fish in BC.

Wild salmon populations have a complex lifecycle and are subject to stresses throughout their freshwater and ocean-going life phases. Fisheries biologists generally agree that current downturns in some pink salmon runs are likely attributable to an interplay of actors, including fluctuations in stream conditions, ocean temperature and currents, predation, and land-based human activities.

The health of both wild and farm salmon is a key priority for government and industry. Governments are monitoring sea lice levels in wild salmon and enhancing fish health activities on farms, while salmon farmers are taking ever greater precautions to ensure their stocks are not exposed to harmful sea lice outbreaks.

MAFF Sea Lice page
DFO Sea Lice report

How do farmers treat salmon that have sea lice?

Treatments are only administered to fish when an outbreak has been confirmed on the farm and is threatening the health of the farmed and/or wild fish. Emamectin benzoate, also called SLICE®, is the primary treatment given to farm fish to treat for sea lice. SLICE® is not a pesticide, it is a drug that is administered to the fish in their feed.

This product is available to farmers by veterinary prescription only and it's use is strictly regulated and controlled. All veterinarian-prescribed drugs have a withdrawal time - a period of time that must pass after treatment ceases before the fish are considered drug free. Fish cannot be harvested for food until after the withdrawal period. The Canadian Food Inspection Agency tests fish destined for market, for drug residues to ensure no trace of any medication is present.

Under what authority is SLICE® administered to fish on BC farms?

Emamectin benzoate (SLICE®) is in the process of being licensed by Health Canada's Bureau of Veterinary Drugs, Health Protection Branch. In the event of an emergency problem, the Bureau of Veterinary Drugs allows the use of products that are in the process of being licensed, yet have not received final approval, through the Emergency Drug Release program and it has been in use for decades by other fish farming countries.

Are there environmental impacts from using SLICE®?

A large amount of scientific information is available internationally on the use of SLICE® in fish. Studies have indicated that potential environmental impacts from using SLICE® are minimal or non-existent. Considering the limited use, strict veterinary controls, and all currently-available scientific information, sea lice treatments do not pose a risk to marine organisms or the aquatic environment.

What other treatments are used to treat sea lice infected fish?

Ivermectin is a licensed prescription product used to treat sea lice infestation in farmed fish. It is widely used to manage parasites on domestic and farm animals, and can also be used on humans.

This product is available to farmers by veterinary prescription only and it's use is strictly regulated and controlled. All veterinarian-prescribed drugs have a withdrawal time - a period of time that must pass after treatment ceases before the fish are considered drug free. Fish cannot be harvested for food until after the withdrawal period. The Canadian Food Inspection Agency tests fish destined for market, for drug residues to ensure no trace of any medication is present.

What are the environmental impacts of using Ivermectin?

Laboratory studies indicate some possible affects of ivermectin on crustaceans; however there is no evidence to indicate that its use in salmon feed has had an impact on the environment. Given the judicious use of this product and precautions taken to reduce the risk of loss of feed into the environment, the risk of impact is low. With the advent of new safer products such as SLICE®, the use of ivermectin has decreased.

IHN VIRUS

What causes IHN virus outbreaks on farms?

The IHN virus is present in wild fish stocks, in particular, sockeye salmon. It is likely that the disease is transferred from wild fish to farmed salmon where it can cause devastating losses to the farmer.

MAFF IHN page

Does IHN virus on farms pose a risk to wild salmon stocks?

The disease is naturally present in wild salmon, and indigenous salmon have always lived with the presence of the virus. Given its natural occurrence in the wild, the risk of IHN farm outbreaks impacting wild stocks is low.

MAFF IHN page

What measures are used to contain the spread of IHN virus on farms?

In the case of an outbreak of the IHN virus, salmon farming companies are required to strict

isolation measures including:

- Enforcing strict disinfection procedures
- Limiting the movement of all personnel, equipment and boats
- Using separate dive teams to survey sites at each farm
- Special procedures for removal and disposal of dead fish
- Special precautions for harvesting to prevent spread of the disease

MAFF IHN page

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What treatment is available for fish infected with the IHN virus?

Affected fish are not treated, as viruses do not respond to antibiotics.

MAFF IHN page

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Can people be affected by the IHN virus?

No. The IHN virus does not pose any threat to human health.

MAFF IHN page

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HUMAN HEALTH AND SAFETY

Is eating farmed salmon safe?

Yes. All salmon – wild and farmed – is considered a healthy food choice that has many proven health benefits. According to the USDA, farmed Atlantic salmon have higher levels of healthy Omega-3 fatty acids than any of the five species of wild Pacific salmon.

Food safety and consumer protection are key priorities of the Canadian Food Inspection Agency (CFIA). The CFIA samples fish to monitor for a wide range of environmental and industrial contaminants including mercury, toxic elements, PCB's, DDT, and other pesticides and dioxins. Fish products including farmed fish are tested to verify that they do not exceed Canadian Guidelines for Chemical Contaminants and Toxins in Fish and Fish Products.

CFIA - Canadian guidelines for chemical contaminants and toxins in fish and fish products

CFIA - Quality Management Program

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Are there traces of antibiotics in the farm fish sold in grocery stores?

Any antibiotics used in human food animals, including fish, must undergo a lengthy and thorough licensing process to ensure that the food product will be safe for human consumption. The antibiotics used in farmed fish are not foreign to humans; they are the same ones prescribed by medical professionals to treat human infections. All medications have a mandatory withdrawal period – a specified amount of time that must pass after administering the medication and before the animal can be harvested for food. The Canadian Food Inspection Agency spot checks farmed fish for possible therapeutant residues. No adverse reaction has been reported as a result of consumption of farmed salmon. More than a billion pounds of farmed salmon are consumed each year.

MAFF Therapeutant (Antibiotic) Use in Aquaculture page

MAFF Therapeutant Use & Recordkeeping page

Does farmed salmon contain PCBs, dioxins and other harmful substances?

All food, including beef, chicken, seafood, grains and vegetables, contains trace levels of persistent organic chemicals such as PCBs. This is because these chemicals are ever-present in the environment in minute quantities due to human use of these chemicals over many decades. These types of persistent environmental pollutants can bio-accumulate through the food chain. Animal flesh with a higher fat content tends to store higher levels of these substances.

Fish feed companies monitor the feed ingredients to ensure they do not contain unacceptable levels of dioxins or other contaminants. The Canadian Food Inspection Agency (CFIA) samples fish to monitor for a wide range of environmental and industrial contaminants including mercury, toxic elements, PCB's, DDT, pesticides and dioxins in order to verify that they do not exceed the Canadian guidelines for chemical contaminants and toxins. Health professionals agree that the health benefits of eating fish far outweigh any potential health risks.

World Health Organization

CFIA - Canadian guidlines for chemical contaminants and toxins in fish and fish products

Does farmed salmon have a higher fat content than wild salmon?

The fat content of farmed Atlantic salmon is closely comparable to that of wild chinook salmon. Of all the salmon species, chinook, sockeye and farmed Atlantic salmon have the highest fat content, averaging from 8.5% to 10.8%. Coho, pink and chum salmon have lower levels, ranging from 3.5% to 5.9%. (USDA 2002 data)

The level of fat in any wild or farmed fish depends on the fish's diet. Feed given to farmed salmon is specifically formulated to be efficiently converted into flesh and to promote good health of the fish.

Does farmed salmon contain artificial colouring?

In addition to the primary ingredients such as fish meal and oil, farmed salmon feed contains several vitamins and minerals, including astaxanthin. Astaxanthin is a carotenoid and anti-oxidant essential for good health and it also gives salmon flesh its distinctive pink colour. Wild salmon get astaxanthin from wild krill and crustaceans, while this is added to the feed that is given to farm- and hatchery-raised fish.

The molecule of the astaxanthin used in feed is identical to the molecule present in wild salmon, although the form added to feed is usually of synthetic origin. Natural sources may also be used, and are made from red fish oil, crayfish extracts, yeast (*Phaffia rhodozyma*) and algae (*Haematococcus pluvialis*). Amounts of these carotenoids added to salmon feed generally range from 70ppm to 30ppm.

NON-SALMON SPECIES

What fish species, other than salmon, are farmed in BC?

In addition to Atlantic, coho, chinook and sockeye salmon, several other species of finfish are being raised on freshwater and marine fish farms. These include:

- Carp
- Arctic Charr
- Sablefish (also known as black cod)
- White Sturgeon
- Tilapia
- Rainbow Trout
- Steelhead Trout
- Wolf Eel

Some experimental licences have been issued for other species, such as Pacific halibut and rockfish, but these species are not currently being farmed.

For more information on non-salmon species - MAFF New Species page

The following species of shellfish are also licensed for culture in BC:

- Geoduck Clam
- Littleneck Clam
- Manila Clam
- Varnish Clam
- Butter clam
- Western Blue Mussel
- Eastern Blue Mussel
- Gallo Mussel
- Native Oyster
- Pacific Oyster
- European Oyster
- Purple Sea Urchin
- Sea Scallop
- Giant Rock Scallop
- Japanese Scallop
- Pink Scallop
- Spiny Scallop

For more information - MAFF Shellfish Aquaculture page

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How many farms are raising sablefish, sturgeon and other non-salmon species?

Over the years, several farmers with salmon aquaculture licences have applied to MAFF to amend their licences to allow the culture of sablefish and/or other species. As of November, 2003, three BC farms are raising hatchery-origin sablefish. White sturgeon are being raised in one land-based facility. About 52 small-scale farms are raising rainbow trout in BC. A small number of facilities are raising freshwater species such as tilapia, carp and trout in land-based lakes, ponds or tank operations.

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How long has sablefish farming been permitted in BC?

MAFF has been granting amendments to salmon aquaculture licences, adding sablefish as a permitted species, since 1995. All issues addressed under the provincial salmon aquaculture policy also apply to the culture of sablefish and other finfish (i.e. fish health, waste management, siting requirements, escape prevention regulations, etc.).

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Have environmental assessments been done on farming these other species?

British Columbia's Environmental Assessment Office conducted an extensive review of the risks of salmon aquaculture in 1997 and the Province accepted the recommendations of this report in developing its aquaculture policies. The extensive regulatory framework developed for salmon aquaculture also applies to other marine finfish species. Policies may be amended where needed in order to address the individual characteristics of other species.

Development of non-salmon species aquaculture will take place under the same tough standards for wastes, fish health, escapes and siting that are applied to the salmon sector. The desirable site characteristics for raising finfish, including adequate current flow to prevent waste build-up and separation from sensitive habitat areas, remain much the same when considering other finfish species.

A federal-provincial introductions and transfers committee was created specifically to consider any potential risks (ecological, genetic or fish health) associated with moving aquatic organisms in the province. The committee is made up of biologists and other fish health professionals who advise government on fish transfer issues.

This committee and a host of regulations and polices are in place to ensure that further development of any finfish aquaculture will take place in a responsible way and will be subject to enforceable standards.

Federal-Provincial Introductions and Transfers Committee page
National Code on Introductions and Transfers of Aquatic Organisms

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Will farming species such as sablefish have negative impacts on the wild fishery?

Two recent reports (one prepared for the Canadian Sablefish Association and one for government) both predict an eventual decline in sablefish prices on world markets. This reduction, however, is predicted to occur irrespective of the success of BC's sablefish aquaculture industry. Although expansion of the BC industry will have some impact, significant challenges will also come from development of the wild and aquaculture sectors in other countries, as well as from other fish species that compete for similar markets.

MAFF New Species page

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If it will cause a decrease in revenue to the wild fishery, why doesn't government prohibit sablefish farming in BC?

The worldwide success of sablefish and halibut aquaculture will not be determined by regulatory action taken at a provincial level. Consumer demand will drive this market, as it does many others. Government's role is not to police or influence consumer markets, but rather to ensure that aquaculture in the province is sustainable and is consistent with legislated practices. Market research indicates that the worldwide demand for both wild and cultured sablefish is on the rise. Any corresponding decrease in price for sablefish is predicted to occur irrespective of BC's aquaculture activities.

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Will sturgeon culture take place in net-pens, as with salmon?

Containment is only one aspect of a sound management regime. Due to the biological needs of salmon, and thanks to the sound management policies in place for salmon aquaculture, marine net-cages provide an ideal rearing environment for salmon.

Factors such as the scale and value of the industry, the biology of the fish, and the fish's environmental needs are considered in determining the best culture methods for different species. For these reasons, land-based systems have been deemed the best method for sturgeon aquaculture. The provincial policies on sturgeon and salmon aquaculture reflect the economic, biological and other differences in their culture.

Will farming these species introduce new diseases or cause other environmental concerns?

Preventive measures are in place to reduce any risk of disease introduction, including an "eggs-only" importation policy and strict hygiene and sanitation controls from the hatchery to the grow-out site. In addition, a federal-provincial introductions and transfers committee (ITC) was created specifically to consider potential ecological, genetic and fish health risks associated with moving aquatic organisms in the province (fish and aquatic plants).

The ITC is made up of biologists and other fish health professionals who advise government on fish transfer issues. This committee, in tandem with a host of regulations and polices, will ensure that further development of any finfish aquaculture will take place in a responsible way and will be subject to enforceable standards.

Federal-Provincial Introductions and Transfers Committee page
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Why start culturing new species now?

The finfish farming industry has shown an interest in farming species such as sablefish and halibut. The decision on which species to culture (and when) is made by individual companies, based on business plans and market demand. The Province supports the development of the aquaculture industry and is responsible for ensuring industry practices are sustainable and are in line with provincial regulations and policies.

In 2001, the Ministry of Agriculture, Food and Fisheries contracted a report on the economic future of the farmed and wild-catch halibut and sablefish industries. The report concluded that the current demand for sablefish exceeds the supply of wild fish and predicts that worldwide declines in wild fisheries will open up new markets for cultured species. This report can be accessed from the MAFF New Species page

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